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Managing portfolio's risk for improving quality in a project oriented manufacture

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ABSTRACT

Iran is a developing country and there are many different infrastructure projects in hand. Some of the manufacturers that produce equipment for infrastructure projects as for oil, gas and energy projects should manage their efforts based on production management and project management practices; these kinds of manufactures are known as project oriented manufacture. It is very important to manage and control manufacturing equipment project with the consideration of the constraints (time, cost, scope and quality). During the project's lifecycle many risks take place, either positive or negative that should be controlled not to have a negative effect on quality of the project. With considering this concept, in this paper we will discuss a framework how to manage risks to eliminate negative effects on the quality of the project.

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1. Introduction:

Project is a temporary attempt carried out to create a unique product, service, or result (PMBOK, 2013). The right Execution of the project management can add great value to an organization. However, some organizations have gained little value from the project management because they have not applied the project management in a proper way (Shi, 2011). Many prior studies have confirmed that most projects do not finish on time and on budget. Some failed to fulfill either the customer's or company's expectations (Miller, 2002). One of the important areas of project management is quality management. Quality management is important in all organizations. It contributes to the success of the project and creates competitive advantage for a project oriented.

Projects are the central activity in many companies and it can be used in manufacturing. Manufacturers that produce equipment for infrastructure projects as for oil, gas and energy projects. These kinds of manufacturers should manage their efforts based on production management and project management practices. One of the management areas is quality that can play an important role to gain a competitive advantage for the company and poor quality is one of the reasons that a project may fail.

Loo et al., (2013) studied international projects through a questionnaire survey and case studies among architectural, engineering, and construction firms operating in the Gulf. An external risk breakdown structure and a framework for foreign AEC firms operating in Gulf Cooperation Council states were developed for users to identify and respond to external risks in a more systematic manner **Error! Reference source not found.**(Loo et al., 2013). Steffey and Anantatmula (2011) provided a new method of radial risk mapping assists management in graphing their risk findings to aid in their proposal analysis. These graphical representations provide firms seeking international markets with a method for selecting those projects with the least risk, thereby increasing their chances of success and maximum profit **Error! Reference source not found.**(Steffey, and Anantatmula, 2011). Fang and Marle (2011) presented an interactions-based risk network model using advanced simulation. The model addresses the limitations of current methods regarding modeling complexity in project risk management (Fang and Marle, 2012). Guebitz et al., (2012) presented risk management ontology for pharmaceutical manufactures based on the GAMP (Guebitz, Schnedl, & Khinast, 2012). Since quality problems has become a key point of a supplier's competitive edge, Sun et al., (2012) presented a quality risk management model for a supplier–assembler structure supply chain. To mitigate quality risks, supply chain members are coordinated by sharing their information. It was found that a longer due-time should be set when a high quality is demanded (Sun et al., 2012). As it can be noticed from the studies there has been less research on risk in a project oriented manufacturing and its effect on preventing quality failures has been done. This paper reviews the literature of risk management and then based on the PMBOK standard (PMI 2013) a structure for risk management for a project oriented manufacture is developed. This structure can be used for further and more detailed researches for management of risk in project oriented organizations.

2. The project oriented manufacture

It has been noticed that in the recent years, organizations are shifting towards a project oriented management pattern (Huemann et al., 2007; Huemann, 2010) to gain more differentiation for dealing with the increase of the environment complexity (Turner et al., 2008; Morris, 1997).

The project oriented manufacturing style of is very different from traditional manufacturing. Project oriented manufactures have a project management office (PMO) and use “management by projects” (PMBOK, 2000; Gareis, 2005) as an organizational strategy (PMBOK, 2000). A project oriented manufacture, produces equipment similar to, yet different from, anything else previously designed and produced that can be referred as “custom designed equipment”. Custom designed equipment is often a sub-system in a larger project as a constructing a refinery plant, building a power station and building a ship. In addition to the engineering and manufacturing of the equipment, the manufacturer of these kind of equipment should often perform services like site preparation, on-site installation, and training.

There are three levels of management in a project oriented manufacture:

- portfolio management,
- project management,
- supply chain management,

1.1. portfolio management

Portfolio is a group of projects, programs, sub portfolios, and operations that have a common strategic objective for an organization (The Standard for Portfolio Management, 2013); and portfolio management is integrating management efforts of a portfolio to achieve strategic objectives of an organization (Teller and Kock, 2013). Usually, the project oriented manufacturers do not focus on delivering a single equipment at a time and are involved in a portfolio of projects at the same time for delivering several main equipment to customers and besides the main equipment, they are involved in supplying spare parts for their earlier project customers (Van Donselaar et al., 2001).

2.1. Project management:

Project management involves planning and control of several conceptually different issues (Kerzner, 2005). They include at least: scope, schedule, cost, risk, quality, and organization (Turner, 1999). From the perspective of the equipment suppliers, the most important issues lie in the management of scope, schedule, cost and quality because those practices define what is required and when. There are several well-established practices for managing these areas. For example, there are tools such as cost breakdown structure and earned value management for planning and controlling costs (PMBOK, 2013). Similarly, there are generic tools for managing risk (e.g. PRAM (Standard for Project Risk Management, 2009)), quality (e.g. QFD0 (Tanık, 2010)), and organizational resources (e.g. OBS0 (Meredith and Mantel, 2005)).

2.2. Project oriented supply chains:

The concept of a project delivery chain as a chain of several interlinked subprojects that together deliver a complete project product to the end customer who is the owner of the whole capital investment project (Lotfi et al., 2017; Turner, 1999; Artto et al., 1998).

Three types of sourcing material (and corresponding supplier) which entail an increasing level of the component's complexity and the supplier's design responsibility (Camuffo et al., 2013):

- the buyer completely designs the component and the supplier just manufactures it (drawings supplied);
- the buyer defines the product concept and the functional parameter, while the supplier works out the design details and manufactures the component (drawings approved); and
- The buyer purchases the component that has been fully designed and manufactured by the supplier (marketed goods).

3. Improving quality through managing risks:

Risk is an uncertain event, set of events, or conditions that if it occurs, has a positive or negative effect on one or more objectives (project or (PMBOK, 2013); but the focus of this paper is on those risks that can negatively affect the outcome of a project-oriented manufacture.

Quality is the degree to which a set of inherent characteristics fulfills requirements. (ISO 9000) Components of requirements in a project can include, but, are not limited to (PMBOK, 2013):

- Solution requirements, including:
 - Functional and nonfunctional requirements;
 - Technology and standard compliance requirements;
 - Support and training requirements;
 - Quality requirements; and
 - Reporting requirements, etc.
 - Project requirements, such as:
 - Levels of service, performance, safety, compliance, etc.; and
 - Acceptance criteria.

Objectives a quality program is aimed at satisfying if we switch to a risk perspective, these common definitions of quality become failure to achieve satisfying. The link between quality and risk is presented in table No. 1:

Table No. 1: The link between quality and risk

Quality	Risks
zero defects	risk of defects
customer satisfaction	risk of customer dissatisfaction
control of process variance	risk of uncontrolled process variance
reliability	risk of product unreliability
security	risk of security breach
fit for purpose	risk of lack of fitness

Risk management includes a group of processes of conducting risk management planning, identification, analysis, response planning, and monitoring and control to increase the probability and impact of positive events, and decrease the probability and impact of negative events (PMBOK, 2013; Practice Standard for

Project Risk Management, 2009). Because of the downstream impact on programs and projects, risk management becomes critical for root cause correction of negative risks or capitalization of positive risks at the organizational and at the portfolio level⁰ (The Standard for Portfolio Management, 2013).

4. A framework for managing risks

Research on using risk management has been examined by different areas in management literature; still, there is not much literature on a framework to use risk management efforts for improving project quality. In this section based on the PMBOK by PMI and other references that has been introduced in the introduction a framework for risk management efforts in a project oriented manufacture has been discussed.

The inputs of this frame work are organizational process assets (OPA), enterprise environmental factors (EEF), stakeholder list and registered risks of projects. At the first level the risk resource management plan should be developed. The next step is to identify and categorize the portfolio risks. Finally, the project manager should analyze and manage the risks to improve the quality. The frame work is showed in the figure No. 1.

Figure 1- framework for managing risks

4.1. Develop Portfolio Risk Management Plan

During this process the way to conduct risk management activities defined. The below objects should be taken to develop the risk management plan:

- Methodology that will be used to identify risks
- Roles and responsibility for risk management
- Estimation of how much the risk efforts will cost
- Timing of the risk efforts throughout the project
- Definition of probability and impact
- Creation of probability and impact matrix

- Stakeholder tolerances (areas that the company and key stakeholders are willing to accept or don't accept risk) and thresholds (is the amount of risk that is acceptable)
- Risk categories
- Definition of how risks will be documented, analyzed and communicated to stakeholders.
- Determination of how should risks be tracked and recorded for use on future

4.2. Identify and Categorizing Risks

Category for the risk should be developed for a better effective management. Although there is great debate over category specifics, the establishment of the classifications must be dependent on the intended purpose of the groupings and the type of analysis being performed (Steffey and Anantatmula, 2011; Khattab et al., 2007). Universally accepted number and type of risk categories do not exist; however, there are many viewpoints and opinions., citing other studies illustrate risk categories ranging from five categories (natural, legal, societal, political, governmental) to four categories (political, financial, cultural, legal) to the basic three categories (political, cultural, legal) (Daniell, 2000). The original 6Ms (machine, method, man power, measurement, milieu/mother nature) used by the Toyota production system that have been expanded by management and maintenance and are referred to as the 8Ms can be used for categorization.

The study on project oriented manufactures risks utilizes the “technical/production”, “logistics & suppliers”, “management” and “Environment”. Although many studies suggest additional categories, such as financial, governmental, technological, political, cultural and social, this study distributes the risks associated with these categories across the four classifications defined above.

To provide management with the ability to graphically depict each project on a radial chart each project and its associated risks should be graded as per the defined criteria and plotted on the radial chart (Steffey and Anantatmula, 2011). The segments should represent a specific risk within its corresponding category, and each radial ring represents the identified risk level, with the highest risks being toward the outer edges of the chart and the lowest risks being toward the center. As points are plotted, they are connected with the adjoining risks to create a radial risk mapping of the overall risks associated with the project **Error! Reference source not found.** (Steffey and Anantatmula, 2011)..

Besides project risks, portfolio risks should be identified and categorized with using prompt lists, brainstorming, nominal group, Delphi, root cause analysis, cause and effect diagram, Influence diagram, assumption analysis, SWOT analysis, fault/force tree analysis or checklist analysis.

4.3. Analyze Risks

Qualitative analyzing of the risks can be performed by a FMEA method. This tabular risk analysis tool is one of the most commonly used methods in quality management to define risks. Also, during equipment development using a Quality by Design approach it is getting more and more important (Guebitz, et al., 2012). For instance, it can be used for the definition of the potentially critical material attributes and process parameters which are subsequently used to define a design space (Adam et al., 2011).

During a FMEA, potential failure modes, their associated causes and the effects of failures are systematically identified (Guebitz, et al., 2012). To evaluate the risk of a failure mode, an assessment is made by calculating the risk priority number. For this purpose, numerical values are assigned for the probability of occurrence (P), detectability of failure (D) and severity of effect (S). Multiplication of P, D and S gives the risk priority number (RPN) (International Standard IEC 608122006).

4.4. Manage Risks

After prioritizing the risk two kinds of risk should be handled. The top risks and the non-critical risks. Top risks are either actively accepted, mitigated, transferred or avoided and the non-critical risks is passively accepted.

Transfer the top risks requires shifting some or all of the negative impact of a threat, along with ownership of the response, to a third party and gives the third party responsibility for its management.

Mitigate the risks implies a reduction in probability and/or impact of an adverse risk event to an acceptable threshold total quality management (TQM) principle and is often more effective than trying to repair the damage after the risk has occurred.

After using one of the transfers, mitigate strategy for the top risks, secondary risks (risks that arise as direct outcome of implementing risk respond strategy) should be analyzed and then the residual risks should be identified and contingency plans should be developed. Residual risks are expected risks to remain after planned responses have been taken, as well as those that have been deliberately accepted.

Avoid the top risks involves changing the project management plan to eliminate the threat entirely (cause). Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise. The project manager may also isolate the project objectives from the risk s impact, or change the objective that is in jeopardy.

Passive acceptance requires no action except to document the strategy, leaving the project team to deal with the risks as they occur.

5. Framework Evaluation

The proposed framework has been examined by a questionnaire Based on statistical analyses (Binomial and Mean tests). Results assumptions will be described below:

Hypothesis 1: Experts' opinion in the questionnaire will follow the normal distribution.

Klrmvgrf-Smimov test results indicate a mismatch for distribution data with normal distribution, but in this all of components don't follow the normal distribution, therefore, nonparametric tests (Ratio Test) were used to measure model.

Hypothesis 2: The model is confirmed by experts.

Based on Klrmvgrf-Smimov test result, the first hypothesis is rejected; then to measure the acceptance / rejection of model, Ratio Test is used. If all components of the hypothesis are confirmed, final hypothesis: "The whole model is approved"; will be approved. The hypothesis was rejected if all the components were rejected. Otherwise, the final judgment about the hypothesis will be difficult. In this study, Likert scale was used for the questionnaire. So, this must be converted to ordinal scale and proportion can be defined as follows:

"Completely agree" and "Agree" options: Ok

"No Comment", "Disagree" and "Completely Disagree" options: Not ok

Then the ratio of three options to five options is 0.6. If the ratio is less than 0.6, the number of people confirming the anthology would increase. So, ith hypothesis is as follows:

$$\begin{cases} H0: P \geq 0.6 & \text{ith component in the model is not approved.} \\ H1: P < 0.6 & \text{ith component in the model is approved} \end{cases}$$

According to the results of this test, the significance level is less than 0.05 Thus H0 will be rejected and H1 will be confirmed with 95% confidence.

Thus, all components of the model were accepted with a confidence of 95% and the final hypothesis: "The whole model is approved" has been confirmed with 95% confidence.

Conclusion:

During the project's lifecycle many changes take place, either positive or negative that should be controlled. In this paper by the base on the PMBOK the concept of quality and risk in a project oriented manufacture had been presented and a risk management structure for a project oriented manufacture was developed. The framework is confirmed by experts. Based on statistical analyses (Binomial and Mean Tests),

proposed framework has been accepted in 95%. This structure can be used for further and more detailed researches for risk management in project oriented organizations by using the AHP method.

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